

Response To Restriction Requirement And Requirement For Election Of Species

Applicants note that the Cover Sheet - Form PTO-326 of the Final Office Action indicates that claims 2 and 8-24 stand withdrawn from consideration.

Applicants respectfully submit that since claim 1, directed to a ceramic heater, is now in condition for allowance for the reasons submitted below, in accordance with MPEP § 821.04, the Examiner should rejoin method of making claims 14 to 16, which now include all the limitations of the ceramic heater of claim 1.

Moreover, it is respectfully requested that claims 17 and 18 be rejoined.

If the Examiner deems that there is any language that would render the claims rejoindable the Examiner is respectfully requested to contact the undersigned to discuss the same.

Moreover, Applicants note that claims 8 and 9-13 have been canceled in the present response without prejudice to the filing of the subject matter thereof in one or more divisional and/or continuation applications. In this regard, it is noted that the subject matter of claims 8 and 9-13 is, in fact, not directed to a species of the subject matter recited in the claims under prosecution, but is directed to a separate invention. As can be seen in the arguments set forth in the instant response, the arguments are directed to subject matter that is different from that recited in these non-elected claims. In particular, each of Applicants' independent claims under prosecution includes a ceramic heater comprising a disc-shaped nitride or carbide ceramic substrata and a heating body formed on a surface of the substrate opposite to a heating surface thereof. The Examiner is respectfully requested to indicate that claims 8-13 are subject to a restriction requirement as these claims are directed to subject matter other than that recited in independents claims 1 and 33.

However, claim 2 is directed to the heating body being arranged so as to embed a part thereof in the ceramic substrate. This claim is being permitted to remain pending subject to rejoinder with allowable claim 1.

For the foregoing reason, Applicants request that the Examiner rejoin the method claims and claim 2 and indicate their allowability with the elected claims.

Response To Rejection Under 35 U.S.C. 1.112

In response to the rejection of claims 7 and 25 under 35 U.S.C. 112, second paragraph, as being indefinite, Applicants respectfully submit that the claims clearly and definitely recite Applicants' invention whereby the rejection of record should be withdrawn.

In this ground of rejection, it is asserted that in claims 7 and 25 it is unclear what are compared elements for the claimed ratio. In response, Applicants respectfully submit that the terminology is not indefinite and direct the Examiner's attention to Applicants' originally filed specification, at page 13, lines 14 to 17, which defines the term. In particular, it is disclosed that, "The aspect ratio at the section of the heating body 2 (width of the heating body/thickness of the heating body) is desirably about 10~10000, preferably 50~5000." Moreover, this language appears in originally presented claims 7 and 25, and the claims were amended to remove the definition of the term aspect ratio in the Amendment Under 37 C.F.R. 1.111, because the term is defined in the specification. However, if the Examiner deems that it would be beneficial to include the definition in the claim, the Examiner is respectfully requested to contact the undersigned, and the claim will be amended to once again explicitly recite the term definition.

Response To Rejection of Claims 1, 3, 5, 26 to 28, 32 and 33 Under 35 U.S.C. § 103(a)

The rejections of record include three rejections, as follows:

Claims 1, 3, 5, 26 to 28, 32 and 33 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Matsumura et al. (hereinafter “Matsumura”), U.S. Patent No. 5,151,871, in view of Kawanabe et al. (hereinafter “Kawanabe”), U.S. Patent No. 6,133,557, or Yoshida et al. (hereinafter “Yoshida”), U.S. Patent No. 6,080,970.

Claims 4, 6 and 29 to 31 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Matsumura in view of Kawanabe or Yoshida, as applied to claims 1, 3, 5, 26 to 28, 32 and 33, and further in view of Okuda et al. (hereinafter “Okuda”), U.S. Patent No. 4,804,823.

Claims 7 and 25 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Matsumura in view of Kawanabe or Yoshida, as applied to claims 1, 3, 5, 26 to 28, 32 and 33, and further in view of Kubota et al. (hereinafter “Kubota”), U.S. Patent No. 5,643,483, or Kimura, U.S. Patent No. 5,331, 134.

The rejections assert that Matsumura shows a ceramic heater having a ceramic substrate (13) with a heating body (14) formed on the surface of the ceramic substrate and a surface opposite the surface having the heating body being a heating surface. The rejections acknowledge that Matsumura does not explicitly show a disc-shaped ceramic substrate. The rejections rely upon Kawanabe or Yoshida, and assert that Kawanabe and Yoshida show a ceramic heater including a disc-shaped ceramic substrate made of aluminum nitride, and that it is taught that the aluminum nitride provides a high resistance of corrosion while providing high heat resistance. The rejections conclude that in view of Kawanabe or Yoshida, it would have been obvious to one of ordinary skill

in the art to adapt Matsumura with a disc-shaped ceramic substrate to accommodate and to heat uniformly a semiconductor wafer which is usually in the form of a disc.

In response to the rejections of record, Applicants respectfully submit that their invention, as recited in independent claim 1, is directed to a ceramic heater comprising a disc-shaped ceramic substrate made of nitride ceramic or carbide ceramic, a heating body formed on a surface of the disc-shaped ceramic substrate, and a surface opposite the surface having the heating body being a heating surface. Moreover, Applicants' invention, as recited in independent claim 33, is directed to a ceramic heater for heating a semiconductor wafer comprising a disc-shaped ceramic substrate made of nitride ceramic or carbide ceramic, a heating body formed on a surface of the disc-shaped ceramic substrate, and a surface opposite the surface having the heating body being a heating surface. Accordingly, each of Applicants' independent claims under prosecution includes a ceramic heater comprising a disc-shaped nitride or carbide ceramic substrata and a heating body formed on a surface of the substrate opposite to a heating surface thereof.

Because the heater according to the presently claimed invention has a disc shape, it has an effect of uniformly heating as compared with a heater having a square shape. Also, the heater according to the presently claimed invention has a substrate made of nitride or carbide ceramic so that the heat conductivity of the heater is high, and the temperature distribution on the heating surface can be made small. This can be seen from the comparison between the Example and the Comparative Example disclosed on pages 26 to 36 of Applicants' specification. In Examples 1 and 2, the temperature difference between maximum and minimum temperatures on the heating surface is 8 and 9 degrees, as seen from Table 1, while the temperature difference in Comparative Example

2, wherein the heater is made of alumina substrate is 22 degrees. Thus, in one aspect, the presently claimed invention provides a very small temperature difference on the heating surface.

In contrast to Applicants' disclosed and claimed invention, Matsumura discloses a heater in which a heating body is formed on an alumina substrate. As realized in the rejections, Matsumura does not disclose a nitride or carbide substrate as disclosed and claimed by Applicants. Moreover, Matsumura does not appear to disclose a disc shape for the upper plate 13 or the conductive thin film 14, but does indicate at column 5, lines 37-41, that the upper plate 13 has longitudinal side and transversal side each of which is in a range of 160 to 180 mm, with the conductive thin film 14 being disclosed at column 5, lines 42-45, to be formed on the whole areas of the underside of the upper plate 13. Accordingly, it would appear that these elements are square or rectangular shaped.

In an attempt to overcome the deficiencies of Matsumura, the rejections rely upon the disclosures of Kawanabe or Yoshida. However, Kawanabe and Yoshida disclose heaters wherein the heating body is embedded in the inside of the ceramic substrate. In this regard, the Examiner's attention is directed especially to the drawings of Kawanabe, and a description of Example 1, at column 6, line 27 et seq. wherein heating resistor 12 is disclosed as being embedded in the base body 11, and to the drawings of Yoshida, and a description of the drawings are column 4, line 16 et seq. wherein strip heating resistor 4 is buried in ceramic substrate 2. Thus, if the distance from the heating body to the heating surface is to be constant, the ceramic covering the heating body is greater in such a construction, so that there a long time to start the rise of temperature after the supply of power is initiated whereby the structure has a lower response time. Such lower response time is

readily evident from the comparison between Example 1 and Example 4 as disclosed in Applicants' specification which is denoted in Table 1 on page 36 of Applicants' specification.

Still further, similar concerns are present in the case of cooling of the heater. Because the heating body is embedded in the substrate of Kawanabe and Yoshida, it is impossible to conduct a rapid cooling by blowing a cooling gas such as air. To the contrary, in the heater according to the presently claimed invention, the heating body is arranged on the surface of the substrate, so that rapid cooling can easily be attained by directly blowing air to the heating body.

Applicants respectfully submit that one having ordinary skill in the art would not have been motivated to combine the disclosures of either of Kawanabe or Yoshida with that of Matsumura. In this regard, each of Kawanabe and Yoshida are directed to wafers and wafer holding apparatus which are structurally different from that disclosed by Matsumura. In particular, Matsumura includes an upper plate 13 and a conductive thin film 14 on the underside of the upper plate 13. In contrast, Kawanabe discloses wafers wherein heating resistor 12 is embedded in the base body 11, and Yoshida discloses a heating resistor 4 buried in the ceramic substrate 2.

However, if for the sake of argument the disclosure of Matsumura was combined with that of Kawanabe or Yoshida, the instantly claimed invention would not be present. In particular, any combination of the documents would not arrive at a ceramic heater comprising a disc-shaped nitride or carbide ceramic substrata and a heating body formed on a surface of the substrate opposite to a heating surface thereof.

Okuda is merely utilized in the rejection of claims 4, 6 and 29-31 in an attempt to establish that it would have been obvious to one of ordinary skill in the art to adapt Matsumura as modified

by Kawanabe or Yoshida with the heating body having the claimed metal particles and oxides to form a desired heating resistance while improving the adhesion of the heating body to the ceramic substrate.

Applicants' note that Okuda does not overcome the deficiencies of Matsumura, Kawanabe and Yoshida. In this regard, Applicants remind the Examiner that Okuda discloses only a quadrangle-shaped heater, and not a disc-shaped heater, as recited in the present claims. Further, Okuda, at column 1, lines 5 to 10, discloses that the heater can be widely used for ordinary houses, electronic parts, industrial equipments and automobiles. The ordinary house heater is fundamentally quadrangle in shape as seen from petroleum fan heater, air conditioner and the like. Further, the electronic parts, printed wiring boards, and LSI are fundamentally quadrangle in shape. Thus, it can be seen that the heater of Okuda is quadrangle shaped.

Still further, the stated motivation in the rejection is to achieve Applicants' invention. Certainly, this type of rejection is improper, because the motivation for combining the prior art must come from the prior art, and not from Applicants' invention. If this ground of rejection is maintained, the Examiner is respectfully requested to point out the specific disclosure that is being relied upon in Okuda to support the rejection, including where Okuda teaches or suggest a mixture sintered body of metal particles and metal oxide, and any motivation for providing such a mixture sintered body.

Still further, each of Kubota and Kimura are merely utilized in the rejection of claims 7 and 25 in an attempt to establish the obviousness of the claimed aspect ratio. However, whether or not these references teach or suggest such an aspect ratio, the references to do overcome the above-noted

deficiencies of Matsumura, Kawanabe and Yoshida, whereby the rejection of claims 7 and 25 is without appropriate basis, and should be withdrawn.

Still further, Applicants remind the Examiner that the present invention resulted from a recognition by the inventors that a ceramic heater containing the presently recited materials of construction is capable of maintaining better temperature control.

If the substrate of a ceramic substrate is made too thin, the distance between the heating body and the substance to be heated becomes too close. As a result, the pattern of the heating body is reflected to the heating surface of the substrate and thus uniform heating of the wafer is impossible. The present invention solves the above drawback of reflecting the heating body pattern to the heating surface by using ceramics (nitride ceramic or carbide ceramic) which have a high thermal conductivity (thermal diffusion becomes fast). Exemplary materials of construction are AlN and SiC.

In order to obtain uniform heating, the present invention uses the substrate as a thermal diffusion plate by separating the heating body from the heating surface as much as possible. As a result, in one aspect of the claimed invention, the heating body is formed on a surface opposite to the support surface positioning a semiconductor wafer as the substance to be heated. That is, such an arrangement of the heating body (arranged on the surface of the substrate opposite to the heating surface) allows the substrate to be made thin, thus improving thermal diffusion, whereby the material having a high thermal conductivity can be utilized as the substrate.

As mentioned above, the present invention resides in the use of a ceramic having a high thermal conductivity, such as AlN or SiC, as the materials of construction for the substrate. As a

result, in one embodiment of the present invention, the substrate itself acts as a plate for conducting thermal diffusion from the heating body to the semiconductor wafer located on the heating surface opposite to the surface provided with the heating body. In other words, according to the present invention, the thermal diffusion is excellent owing to the material having a high thermal conductivity and the heating body is formed on the surface of the substrate opposite to the surface positioning the semiconductor wafer, so that the distance of ensuring the sufficient thermal diffusion for uniform heating or distance between the heating surface and the heating body can be ensured without thickening the ceramic substrate (as the substrate becomes thin, thermal capacity becomes small).

From the above, Applicants respectfully submit that a prima facie case of obviousness has not been established, and the rejections should be withdrawn. However, even if a prima facie case of obviousness were established in this case, the instantly claimed invention yields unexpected results sufficient to rebut a prima facie case of obviousness. In this regard, In re Soni, 34 U.S.P.Q.2d 1684, 1687-1688 (Fed. Cir. 1995), held that a showing of substantially improved results for the invention, and a statement that results were unexpected suffices to establish unexpected results absent evidence to the contrary. Id. at 1687-88. In the instant case, the superior characteristics of the claimed invention are disclosed throughout the specification, and are also shown in Table 1 on page 36 of the application.

Moreover, Applicants direct the Examiner's attention to the Declaration Under Rule 132 of Yasutaka Ito which is being submitted concurrently herewith to address the issues raised in the Final Office Action, and accordingly should be considered to be timely submitted at the present time. In this regard, the Declaration was originally prepared in view of rejections based upon Okuda, U.S.

Patent No. 4,804,823, which rejection have not been repeated in the Final Office Action. However, the rejection presently uses Kawanabe and Yoshida, and the structures disclosed by each of Kawanabe and Yoshida are similar to that disclosed by Okuda. Therefore, the Declaration is being submitted in response to issues raised in the Final Office Action with respect to the newly-instituted rejections based upon Matsumura in view of Kawanabe or Yoshida.

The Examiner is referred to the Declaration for its discussion of the benefits of having a heating body arranged on the surface of the substrate as compared to being embedded therein as well as to temperature uniformity benefits associated with having a disc-shaped ceramic substrata of nitride or carbide as recited in Applicants' claims. For example, as can be seen from a review of the Declaration, it discusses that when the heating body is arranged on the surface of the substrate, the distance for thermal diffusion can sufficiently be ensured as compared with the case of embedding the heating body in the substrate and also the temperature uniformity of the heating surface is excellent. In contrast, when the heating body is embedded n the body of the substrate, the distance between the heating body and the heating surface becomes relatively small and the thermal distribution of the heating body pattern is reflected to the heating surface and hence the temperature difference of the heating surface becomes large.

Thus, Applicants respectfully submit that the only teaching or suggestion that would lead one having ordinary skill in the art to arrive at Applicants' invention is within Applicants' disclosure, and the use of such disclosure by the Examiner is improper. In order to support the conclusion that the claimed invention is either anticipated or rendered obvious over the prior art, the prior art must either expressly or inherently teach the claimed invention or the Examiner must present a convincing

line of reasoning why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references. Ex parte Clapp, 227 U.S.P.Q. 972 (B.O.A. 1985). There is absolutely no convincing line of reasoning present here that would lead one having ordinary skill in the art to arrive at Applicants' disclosed and claimed invention.

Additionally, each of the dependent claims is patentable over the prior art of record in view of the fact that each of these dependent claims includes the limitations of the independent claims. Moreover, each of the dependent claims is patentable over the prior art of record because it would not have been obvious to one having ordinary skill in the art to incorporate such dependent claim features into the invention as more broadly recited in the independent claims.

Accordingly, the 35 U.S.C. 103 rejections should be withdrawn as improper, and all of the claims should be indicated as allowable over the prior art.

CONCLUSION

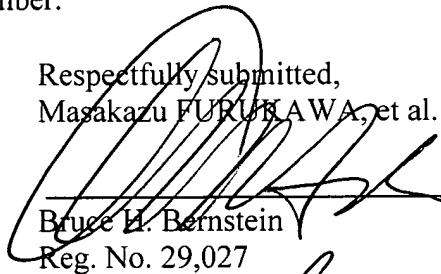
For the reasons advanced above, Applicants respectfully submit that all pending claims patentably define Applicants' invention.

Allowance of the application with an early mailing date of the Notice of Allowance and allowability is therefore respectfully requested.

Should the Examiner have any further comments or questions, the Examiner is invited to contact the undersigned at the below-listed telephone number.

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